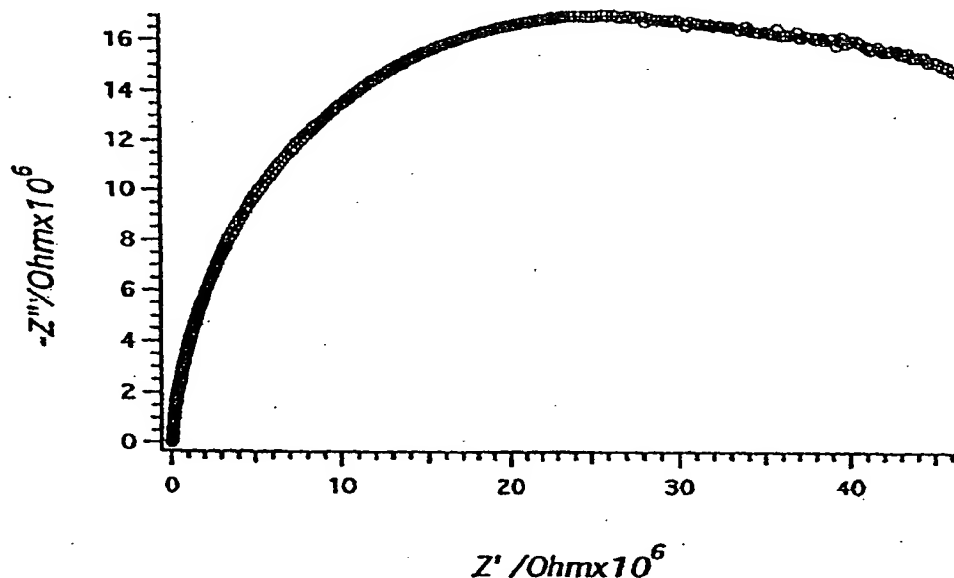




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(54) Title: POLYMERIC MATERIAL WITH ANTISTATIC PROPERTIES AND METHOD FOR OBTAINING IT



(57) Abstract

A polymeric material with antistatic properties, characterised by comprising a dispersion of ions within a polymeric matrix containing heteroatoms.

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POLYMERIC MATERIAL WITH ANTISTATIC PROPERTIES AND METHOD FOR OBTAINING IT

This invention relates to a polymeric material with antistatic properties and a method for its preparation.

5 It is well known that surfaces formed from insulating materials can as a result of various phenomena (principally friction) become charged with static electricity. This can cause various problems such as the triggering of electrical discharges, even by walking on a floor, malfunctioning and faults in electronic processors, peripherals or electronic instrumentation, risk of flammable
10 solvent ignition, powder explosion, and a sense of personal discomfort, including a sensation of nausea.

The solution to this problem is to make the surface concerned, or the entire article, slightly conductive by lowering its resistance from the 10^{10} - 10^{18} Ω/cm normally presented by an insulating surface, to 10^8 - 10^{10} Ω/cm or
15 sometimes less. This is achievable by:

- a) depositing or forming a conductive film on the surface;
- b) adding a compound to the material to increase its conductivity.

In this manner the electrostatic charges accumulate with greater difficulty because they dissipate almost instantaneously on formation.

20 Those chemical compounds possessing this property are known as antistatic agents. The most usual mechanism by which these disperse such charges is to bind the moisture present in the atmosphere, to form a highly conductive layer on the article surface. These compounds are known as surface-active antistatic agents and are able to lower the resistance of a
25 plastic material from 10^{14} - 10^{16} Ω/cm . Another mechanism utilized is to dope the material with a conductive product. Such products are known as

conductivity additives and can reduce the electrical resistance of a material to as low as 10^1 - 10^{-2} Ω /cm. Antistatic agents are further divided into non-lasting and permanent agents. Non-lasting antistatic agents usually consist of compounds which are variously applied to surfaces to inhibit static energy formation. with use, these degrade spontaneously and their reapplication must be preceded by a suitable process for removing any residues.

This is the case with antistatic agents sprayed onto terminals or tables used for maintenance and assembly of electronic circuits, and those used in fabric production and processing.

Permanent antistatic agents are directly incorporated into plastic materials or into synthetic fibres. They are therefore substances compatible with and soluble in the material to be made antistatic. They have to:

- a) act for a considerable period;
- b) not volatilize and not be removed by wear or the cleaning operations to which the article is subjected. Their life is not indefinite but is however generally comparable to the useful life of the article.

Their life is not indefinite because such substances gradually migrate with time towards the material surface, making it slightly conductive.

Antistatic agents with surface activity are usually incorporated into the material at a concentration of 0.1-2.5% and in some special cases up to 5-7%. They are generally classified as follows:

Cationic antistatic agents: these consist of quaternary ammonium salts, chlorides, nitrates, hydrophosphates, 4-toluenesulphonates or other phosphonium salts. They are not suitable for incorporation into materials which come into contact with food. Their cost is relatively high.

Anionic antistatic agents: these consist of sodium alkylsulphonates, alkylphosphonates or alkylthiocarbamates. They are generally used in PVC mixtures.

5 *Non-ionic antistatic agents:* these consist of ethoxylates and propyloxylates of long chain alcohols, long chain amines, fatty acid amides, polyethyleneglycol esters with fatty acids or alkylphenols, glycerin mono and diesters with fatty acids, or sorbitol esters. They are the most widespread and versatile antistatic agents. They are generally liquid or have a waxy consistency.

10 *Organometallic antistatic agents:* these consist of alkyltitanates or alkylzirconates. They are thermally very stable and migrate fairly slowly within the polymer. Their action is little influenced by moisture.

Conductive antistatic agents are usually incorporated into the material at a concentration of 5-10%, but which in some cases can reach 20%. Antistatic agents of this type include carbon black, metal powders or fibres (of
15 copper or aluminium), carbon fibres or metallized glass, special polymers such as polyacetylene, polypyrrol, polythiophene and polyaniline.

The antistatic effect of a substance is verified by measuring the surface resistance (in accordance with UNI 8298/10 or ASTM D257) or volume resistance (in accordance with UNI 8298/10 or DIN 53482). Their
20 capacity to disperse charges deriving from friction is determined by measuring the half life of the charge in seconds, ie the time within which the accumulated charge is halved (in accordance with DIN 53486 E).

The degree of antistatic protection is usually quantified as follows:

Electrical resistance	Degree of antistatic protection
$>10^{13} \Omega/\text{cm}$	None
$10^{12}-10^{13} \Omega/\text{cm}$	Low
$10^{11}-10^{12} \Omega/\text{cm}$	Modest
$10^{10}-10^{11} \Omega/\text{cm}$	Good
$<10^{10} \Omega/\text{cm}$	Excellent

Commercially available antistatic agents are mostly suitable for a wide range of applications, even though they are particularly provided for addition to synthetic fibres or polyolefins (PP, PE, PS). They are not often available as the pure active principle, but are sold incorporated into a polymeric matrix containing 10-50% of active principle.

An object of the invention is to prepare a material having good conductivity which can be used for antistatic surface coatings and be easily applied to any surface, with the facility for preparing it in transparent form rheologically suitable for atoxic use.

This and other objects which will be apparent from the ensuing description are attained according to the invention by a polymeric material with antistatic properties as defined in claim 1.

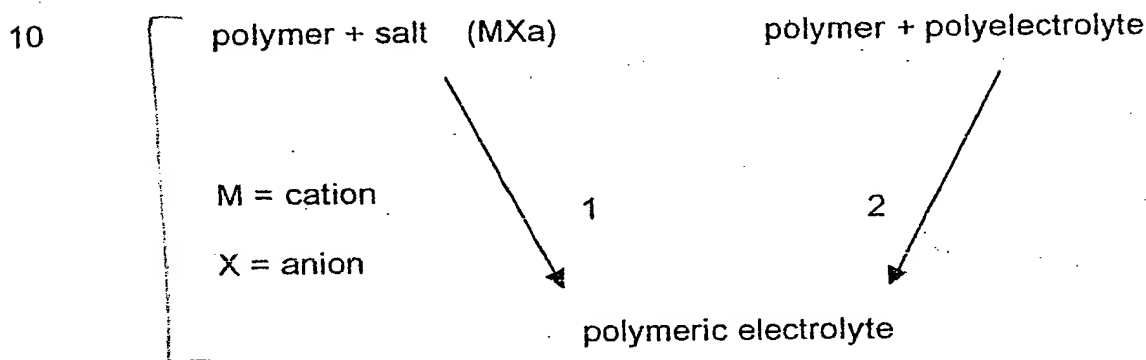
The method for preparing the antistatic polymeric material of the invention is defined in claim 32.

A preferred and other embodiments of the invention are described in detail hereinafter with reference to the accompanying figure showing the variation in the impedance of a polymeric material of the invention as a function of frequency (the horizontal axis of the diagram represents the real

component of the impedance and the vertical axis represents the imaginary component of the impedance; the frequency increases from right to left).

In its general lines the polymeric material with antistatic properties according to the invention (polymeric electrolyte) can be prepared by the general scheme shown hereinafter, using two different procedures 1) and 2).

Procedure 1) comprises reacting a suitable polymer with a particular salt of the low lattice energy under conditions of absolute absence of moisture. An alkaline metal salt, an alkaline earth metal salt or a salt of a transition metal of block d and f is preferably used.



Procedure 2) comprises doping a suitable polymer with a particular polyelectrolyte under conditions of absolute absence of moisture, in the presence or absence of solvents depending on the type of polymer.

15 The polymer used for preparing the polymeric electrolyte according to the invention generally consists of macromolecules containing in their chain heteroatoms such as O, N, P, Si, S, Se, able to coordinate the salt ions.

The anhydrous salts are obtained either by decrepitating the corresponding salt hydrates at high temperature under vacuum (less than
20 about 10^{-3} mbar), or by direct synthesis.

The polymeric electrolyte obtained by procedure 1) or by procedure 2) is homogeneous and has good rheological characteristics and excellent ionic

conductivity, able to offer an antistatic protection defined as "excellent" on the basis of the aforegiven classification.

The following examples further clarify the invention.

**A) Preparation of salts and polyelectrolytes (by direct
5 synthesis)**

EXAMPLE A.1

2 grams of metal lithium are fed under a rigorously inert argon atmosphere into a 250 ml flask. The apparatus, consisting of a flask provided with a reflux condenser, a dropping funnel and connectors for applying
10 vacuum, is placed in a dry box with an argon atmosphere. About 100 ml of n-chlorobutane are added to the lithium via the dropping funnel. The mixture obtained is allowed to react for about eight hours under an argon flow at the boiling point of the chlorobutane. On termination of the reaction it is found that a violet floury product has formed. The reaction takes place quantitatively.

15 On drying the product obtained, by leaving it for about two days under a vacuum of 10^{-3} mbar, a perfectly anhydrous solid is obtained.

Analyses show that this compound is perfectly anhydrous lithium chloride with almost zero lattice energy.

EXAMPLE A.2

20 Operating under the same conditions as Example A.1, one gram of metal magnesium is reacted with 100 ml of n-chlorobutane in a nitrogen atmosphere. After two hours the reaction produces a greyish solid of floury appearance.

The compound obtained is dried under vacuum for six hours, to obtain
25 a white powder. Analyses show this powder to be magnesium chloride in δ (delta) form.

EXAMPLE A.3

0.5 g of metal magnesium in powder form (50 mesh) are placed in the reactor described in Example A.1, and 30 ml of 1-chlorobutane are added. The mixture is then heated under reflux for two hours. It is then allowed to cool to ambient temperature, after which the overlying liquid is removed by decanting. The solid residue is washed four times with n-hexane and then dried under vacuum.

1.8 g of a floury white solid are obtained (Mg_{found} 24.3%; calculated for $MgCl_2$ 25.5%).

10 EXAMPLE A.4

4.0 g of metal magnesium in powder form (50 mesh) are placed in the described reactor, and 60 ml of 1-chloropropane are added. The mixture is then heated to reflux temperature for 2^h30^m. A white solid forms and is separated by decanting, washed with n-hexane and dried under vacuum.

15 Yield: 14.5 g (Mg_{found} 24.1%).

EXAMPLE A.5

3.0 g of metal magnesium in powder form are reacted with 80 ml of 1-chloropentane as indicated in Examples A.1 and A.2.

The mixture is then heated to reflux temperature for three hours.

20 11 g of product in the form of a floury white solid are obtained (Mg_{found} 23.5%).

EXAMPLE A.6

3.0 g of metal magnesium in powder form are treated with 100 ml of 1-chlorohexane and reacted at reflux temperature for three hours as in the preceding examples.

25 A floury white solid is obtained.

Yield: 11.5 g (Mg_{found} 24.5%).

EXAMPLE A.7

3.0 g of metal magnesium are treated with 100 ml of 1-chloroheptane at reflux temperature for three hours.

5 12 g of floury white product are obtained (Mg_{found} 23.5%).

EXAMPLE A.8

3.0 g of metal magnesium are placed in the described reactor and 100 ml of 1-chlorooctane are added. The mixture is heated for four hours.

11.8 g of a white solid product are obtained.

10 Yield: 11.8 g (Mg_{found} 23.6%)

EXAMPLE A.9

3.0 g of metal magnesium in powder form are treated with 100 ml of 1-chlorooctane, proceeding as in the preceding example. The mixture is heated for four hours. A white solid product is obtained.

15 Yield: 11.5 g (Mg_{found} 23.8%)

EXAMPLE A.10

100 ml of 1-chlorobutane are added to a mixture consisting of 4.0 g of metal magnesium in powder form (50 mesh) and 1.0 g of metal zinc in powder form (100 mesh).

20 The mixture obtained in this manner is heated to reflux temperature under strong agitation for eight hours. It is cooled to ambient temperature and the solid which forms is separated by decanting, is repeatedly washed with n-hexane and dried.

25 17.0 g of a grey-white product are obtained (Mg_{found} 9.7%, Zn_{found} 2.7%).

EXAMPLE A.11

Proceeding as in Example A.11, 150 ml of chlorobutane are added to a mixture composed of 4.0 g of metal magnesium and 1.5 g of metal zinc.

The mixture obtained in this manner is heated to reflux temperature for six hours. The formed product is separated by decanting, washed three times
5 with hexane and dried.

Yield 16.2 g (Mg_{found} 19.7%, Zn_{found} 2.14%).

EXAMPLE A.12

A mixture consisting of 4.0 g of magnesium in powder form and 0.2 g of zinc in powder form is treated with 200 ml of 1-chlorobutane.

10 The mixture obtained in this manner is heated to reflux temperature for four hours. A grey-white product is obtained.

Yield 15.8 g (Mg_{found} 22.5%, Zn_{found} 0.56%).

EXAMPLE A.13

100 ml of 1-chlorobutane are added to 4.0 g of metal magnesium in
15 powder form (50 mesh) mixed with 1.0 g of metal copper in powder form (40 mesh).

The mixture obtained in this manner is heated to reflux temperature under strong agitation for five hours. The formed solid is separated by decanting, washed repeatedly with n-hexane and dried under vacuum.

20 16.5 g of a white-yellow solid are obtained (Mg_{found} 21.5%, Cu_{found} 2.9%).

EXAMPLE A.14

A mixture composed of 3.0 g of metal magnesium in powder form and 0.1 g of metal lithium is placed in the described reactor and 60 ml of 1-
25 chlorobutane are added.

The mixture is then heated to reflux temperature under strong agitation for six hours.

12 g of a white solid are obtained (Mg_{found} 24.8%).

EXAMPLE A.15

5 60 ml of 1-chlorobutane are added to 3.0 g of metal magnesium in powder form, intimately mixed with 0.8 g of lithium chloride.

The mixture obtained in this manner is heated to reflux temperature under strong agitation for six hours. The formed solid is separated, washed with hexane and dried, to give 12.2 g of a white solid (Mg_{found} 24.9%).

10 EXAMPLE A.16

One gram of metal lithium is reacted with twice the molar quantity of polyethyleneglycol. The reaction is conducted under reflux at a temperature of about 60°C in a rigorously inert argon atmosphere. The reaction continues for about 24 hours, during the course of which the lithium dissolves completely
15 with the development of hydrogen.

In this manner the lithium alcoholate of polyethyleneglycol 400 is obtained.

EXAMPLE A.17

1 g of metal lithium is reacted with 30 ml of absolute ethyl alcohol.
20 Separately, 20 g of tannic acid (pure, from the ester) are dissolved in 100 ml of absolute ethyl alcohol. The two solutions are then mixed together. The operations are conducted in a rigorously inert argon atmosphere.

The alcohol is then distilled off and the residue dried under vacuum for 6 hours, to obtain anhydrous lithium tannate.

25 The following polyacids:

- polymethacrylates,

- polystyrenesulphonates,
- poly(θ ,1-glutamix) acid,
- poly(sodium trimethylene oxyethylene)

and the following polybases:

- 5 - polyallyldimethylammonium chloride,
 - cationic chitosans,
 - poly-(4-butylpyridinium bromide)-ethylene,
 - poly-(2-N-methylpyridinium iodide)-ethylene,
 - polyallylammonium phosphate,
- 10 can be used in the same manner as the polyethyleneglycol of Example A.16
 and the tannic acid of Example A.17 to obtain different polyelectrolytes usable
 in procedure 2) of the aforeshown general scheme.

Alkaline metals, alkaline earth metals and transition metals of block d
and f can be used as cations.

- 15 Usable anions are those generated by halogens and metalloids of the
 oxygen and nitrogen group.

B) Polymers

- All types of polymers can be treated which in their chain have polar
 functional groups or heteroatoms such as O, N, P, Si, S, Se and are able to
20 coordinate metal ions and anions.

 A list is given hereinafter of commercially available natural and
 artificial polymeric materials which can be treated as described in this
 invention.

NATURAL AND SEMI-SYNTHETIC MATERIALS:

- 25 B1 - Plastic materials from casein: galactite, lanital.

B2 - Cellulose and derivatives: cellulose esters, rayon, celluloid, nitrocellulose.

RESINS OBTAINED BY POLYCONDENSATION:

- B3 - Phenolic resins: novolac resins.
- 5 B4 - Aminoplasts.
- B5 - Aniline resins.
- B6 - Furan resins.
- B7 - Ketone resins.
- B8 - Epoxy resins.
- 10 B9 - Alkyd resins.
- B10 - Polyester resins.
- B11 - Polyether resins.
- B12 - Polyamide resins.
- B13 - Sulphonamide resins.
- 15 B14 - Silicones.
- B15 - Thiochol polythioethers.

RESINS OBTAINED BY POLYMERIZATION

- B16 - Polyvinyl esters: PVB, PVA.
- B17 - Polyvinyl ethers.
- 20 B18 - Polyacetals.
- B19 - Polyvinylpyrrolidone.
- B20 - Coumarin resins, polyvinylcarbazole.
- B21 - Polyacrylic resins: polymethyl-methacrylate.

POLYADDITION RESINS

- 25 B22 - Polyurethanes.

C) Preparation of polymeric electrolytes

EXAMPLE C.1 (preparation of the polymeric electrolyte polyethyleneglycol/MC1x, where $M=Li^+$, Mg^{++} , and $x=1$ or 2)

The lithium or magnesium salt is previously dissolved in ethyl acetate. A solution of polyethyleneglycol in the same solvent is prepared separately. 5 the two solutions obtained in this manner are then mixed together. After heating under reflux for about one hour, the solvent is removed by applying vacuum to 10^{-3} mbar and heating to a temperature of about $100^{\circ}C$. Residual solvent traces are eliminated by placing the material under high vacuum of 10^{-6} mbar for two days.

10 EXAMPLE C.2 (synthesis of the polymeric electrolyte polyethyleneglycol-dimethylpolysiloxane)

A quantity of polyethyleneglycol-dimethylpolysiloxane is dissolved in perfectly anhydrous ethyl alcohol. A solution of lithium or magnesium salts dissolved in the same solvent is prepared separately. The solutions obtained 15 in this manner are then mixed together. The solvent is then removed under a vacuum of 10^{-3} mbar at a temperature of about $5-10^{\circ}C$.

EXAMPLE C.3 (preparation of a single-component epoxy resin/MC1x, where $M=Li^+$, Mg^{++} , and $x=1$ or 2)

The commercial single-component epoxy resin is directly doped by 20 incorporating into it the lithium or magnesium salts prepared as described until they have completely dissolved.

EXAMPLE C.4 (polymeric electrolyte based on two-component epoxy resins)

The component B of the epoxy resin is treated with a quantity of salt, 25 prepared in accordance with one of Examples A1-A17, equal to 0.5-20 wt% of said component, depending on the final characteristics required for the

polymeric electrolyte. After the salt has completely dissolved in the component B, accomplished in a controlled atmosphere at high temperature, the component B is mixed with the component A, the product obtained being ready for application by habitual processes.

5 EXAMPLE C.5 (synthesis of polymeric electrolytes by treating the polymers listed under point B with the salts listed under point A)

 Polymeric electrolytes can be obtained from the polymers listed in Examples B.1-B.22 by treating these either with the salts prepared in accordance with Examples A.1-A.15 by using procedure (1) of the
10 aforeindicated general scheme, or with the electrolyte prepared in accordance with Examples A.16 and A.17 by using procedure (2) of the said general scheme.

 In the most cases the quantity of dopant to be dissolved in the polymer is 0.5-20 wt% of the polymer.

15 All the polymeric materials prepared in accordance with the invention have the following characteristics:

- good electrical conductivity, less than $10^{10} \Omega/\text{cm}$,
- usable directly as a coating substance, easily applied to any surface to be made antistatic,
- 20 - good transparency, enabling it to be coloured if desired,
- absolute atoxicity, enabling it to be used in contact with food, for example for internally coating silos, etc.

C L A I M S

1. A polymeric material with antistatic properties, characterised by comprising a dispersion of ions within a polymeric matrix containing heteroatoms.
- 5 2. A polymeric material as claimed in claim 1, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of at least one salt.
3. A polymeric material as claimed in claim 2, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of at
10 least one inorganic salt.
4. A polymeric material as claimed in claim 2, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of at least one organic salt.
5. A polymeric material as claimed in claim 2, characterised in that the
15 ions dispersed within the polymeric matrix originate from the dissociation of at least one polyelectrolyte.
6. A polymeric material as claimed in claim 3, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of a halide.
- 20 7. A polymeric material as claimed in claim 6, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of a chloride.
8. A polymeric material as claimed in claim 7, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of a
25 chloride of an alkaline metal, an alkaline earth metal or a transition metal of block d and f.

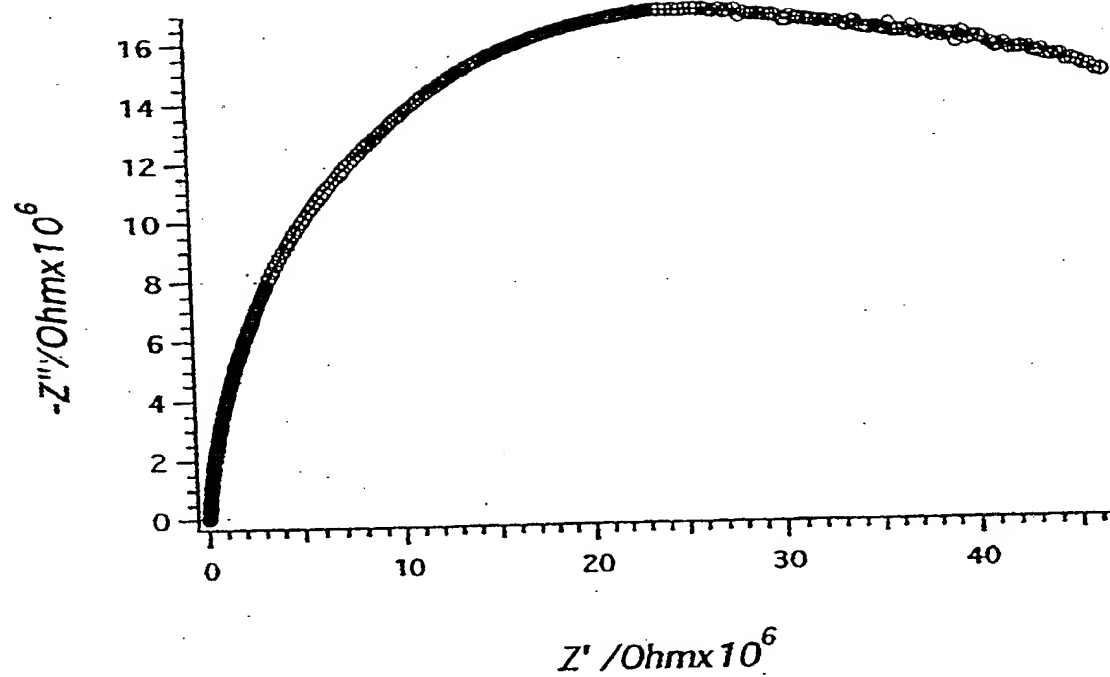
9. A polymeric material as claimed in claim 3, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of lithium chloride.
10. A polymeric material as claimed in claim 3, characterised in that the
5 ions dispersed within the polymeric matrix originate from the dissociation of sodium chloride.
11. A polymeric material as claimed in claim 3, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of potassium chloride.
- 10 12. A polymeric material as claimed in claim 5, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of lithium tannate.
13. A polymeric material as claimed in claim 5, characterised in that the
15 ions dispersed within the polymeric matrix originate from the dissociation of a polymethacrylate.
14. A polymeric material as claimed in claim 5, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of a polystyrenesulphonate.
15. A polymeric material as claimed in claim 5, characterised in that the
20 ions dispersed within the polymeric matrix originate from the dissociation of poly(α ,1-glutamic) acid.
16. A polymeric material as claimed in claim 5, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of poly(sulphonate trimethylene oxyethylene) acid.

17. A polymeric material as claimed in claim 5, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of the lithium alcoholate of polyethyleneglycol 400.
18. A polymeric material as claimed in claim 5, characterised in that the
5 ions dispersed within the polymeric matrix originate from the dissociation of polyallyldimethylammonium salt.
19. A polymeric material as claimed in claim 5, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of a cationic chitosan.
- 10 20. A polymeric material as claimed in claim 5, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of a poly-(4-butylpyridinium)-ethylene salt.
21. A polymeric material as claimed in claim 5, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of a
15 poly-(2-N-methylpyridinium)-ethylene salt.
22. A polymeric material as claimed in claim 5, characterised in that the ions dispersed within the polymeric matrix originate from the dissociation of a polyallylammonium salt.
23. A polymeric material as claimed in claim 1, characterised in that the
20 polymeric matrix pertains to at least one polymer having, in its chains, polar functional groups or heteroatoms such as O, N, P, Si, S, Se and able to coordinate metal ions and anions.
24. A polymeric material as claimed in claim 23, characterised in that the polymeric matrix pertains to a plastic material from casein.
- 25 25. A polymeric material as claimed in claim 23, characterised in that the polymeric matrix pertains to a material based on cellulose or its derivatives.

26. A polymeric material as claimed in claim 23, characterised in that the polymeric matrix pertains to a resin obtained by polycondensation.
27. A polymeric material as claimed in claim 26, characterised in that the polymeric matrix pertains to a resin included in the group comprising aminoplasts, aniline resins, furan resins, ketone resins, epoxy resins, alkyd resins, polyester resins, polyether resins, polyamide resins, sulphonamide resins, silicones and polythioethers.
28. A polymeric material as claimed in claim 1, characterised in that the polymeric matrix pertains to a resin obtained by polymerization.
29. A polymeric material as claimed in claim 28, characterised in that the polymeric matrix pertains to a resin included in the group comprising polyvinyl, ethers, polyacetals, polyvinylpyrrolidone, coumarin resins and polyacrylic resins.
30. A polymeric material as claimed in claim 1, characterised in that the polymeric matrix pertains to a resin obtained by polyaddition.
31. A polymeric material as claimed in claim 30, characterised in that the polymeric matrix pertains to a polyurethane resin.
32. A method for preparing a polymeric material with antistatic properties claimed in one or more of claims 1 to 31, characterised by introducing into the polymeric matrix of a resin containing heteroatoms, in the absence of moisture, at least one electrolyte having a very high degree of purity in terms of the presence of polar molecules able to bind to the ionic lattice of said electrolyte.
33. A method as claimed in claim 32, characterised by reacting the resin containing heteroatoms with a salt having low lattice energy.

34. A method for preparing a polymeric material with antistatic properties as claimed in claim 32, characterised by reacting the resin containing heteroatoms with an inorganic salt.
35. A method for preparing a polymeric material with antistatic properties as
5 claimed in claim 32, characterised by reacting the resin containing heteroatoms with an organic salt.
36. A method as claimed in claim 32, characterised by utilizing the polymeric matrix of a resin obtained by polycondensation.
37. A method as claimed in claim 32, characterised by doping the resin
10 containing heteroatoms with a polyelectrolyte.
38. A method as claimed in claim 32, characterised by doping the resin containing heteroatoms with a polyelectrolyte in the presence of solvents.
39. A method as claimed in claim 32, characterised by utilizing the polymeric matrix of a resin obtained by polymerization.
- 15 40. A method as claimed in claim 32, characterised by utilizing the polymeric matrix of a resin obtained by polyaddition.

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PATENT COOPERATION TREATY

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PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Rule 71.1)

Date of mailing (day/month/year)	15.05.2001
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Applicant's or agent's file reference 701.430	IMPORTANT NOTIFICATION
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International application No. PCT/IT00/00005	International filing date (day/month/year) 05/01/2000	Priority date (day/month/year) 07/01/1999
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Applicant ALBERTINI, Renzo et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/	Authorized officer
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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 701.430	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/IT00/00005	International filing date (day/month/year) 05/01/2000	Priority date (day/month/year) 07/01/1999
International Patent Classification (IPC) or national classification and IPC C08K3/00		
Applicant ALBERTINI, Renzo et al.		
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 4 sheets, including this cover sheet.</p> <p><input type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of sheets.</p>		
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application 		
Date of submission of the demand 24/07/2000	Date of completion of this report 15.05.2001	
Name and mailing address of the international preliminary examining authority: <div style="display: flex; align-items: center;"> <div> European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 </div> </div>	Authorized officer Sperry, P Telephone No. +49 89 2399 8298	



**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/IT00/00005

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-14 as originally filed

Claims, No.:

1-40 as originally filed

Drawings, sheets:

1/1 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/IT00/00005

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	13-22,24,25
	No:	Claims	1-12,23,26-40
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-40
Industrial applicability (IA)	Yes:	Claims	1-40
	No:	Claims	

2. Citations and explanations
see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

- D1: EP-A-0 555 197 (MONSANTO CO) 11 August 1993 (1993-08-11)
- D2: EP-A-0 603 147 (MONSANTO CO) 22 June 1994 (1994-06-22)
- D3: EP-A-0 423 602 (GEN ELECTRIC) 24 April 1991 (1991-04-24)
- D4: DATABASE WPI Section Ch, Week 199214 Derwent Publications Ltd., London, GB; Class A23, AN 1992-108789 XP002134668 & JP 04 046960 A (TOKYO INK KK), 17 February 1992 (1992-02-17)
- D5: DATABASE WPI Section Ch, Week 199144 Derwent Publications Ltd., London, GB; Class A23, AN 1991-321694 XP002134669 & JP 03 215588 A (KANEBO LTD), 20 September 1991 (1991-09-20)

1. Documents D1 to D5 relate all to polymeric material with antistatic properties. The compositions contain a thermoplastic polymer containing heteroatoms (ABS, Nylon, polyphenylene ether...) and a dispersion of ions (LiCl, NaCl, Li stearate...). Also the method for preparing the polymeric material with antistatic properties is disclosed in D1 to D5. It follows that the subject-matter of claims 1 to 12, 23, 26 to 40 lacks novelty with respect to the prior art.
2. Claims 13 to 22 relate to polymeric materials in which the ions dispersed within polymeric matrix originate from the dissociation of polymeric salts. This feature is not disclosed in the prior art. However such polymeric salts are known. It was therefore obvious from the skilled man in the art to use such polymeric salts in polymeric material in order to provide them antistatic properties.
3. Claims 24 and 25 relates to natural polymers which in practice have antistatic properties, therefore it is not clear why it is necessary to provide them antistatic properties?

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/IT 00/00005

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C08K3/00 C08K5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C08K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 555 197 A (MONSANTO CO) 11 August 1993 (1993-08-11) claims 1-30	1-3, 6-11, 23, 26-40
X	EP 0 603 147 A (MONSANTO CO) 22 June 1994 (1994-06-22) claims 1-6	1-3, 6-9, 26-40
X	EP 0 423 602 A (GEN ELECTRIC) 24 April 1991 (1991-04-24) claims 1-15	1-3, 6-9, 26-40
	-/-	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"Z" document member of the same patent family

Date of the actual completion of the international search

3 April 2000

Date of mailing of the international search report

13/04/2000

Name and mailing address of the ISA

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Authorized officer

Siemens, T

INTERNATIONAL SEARCH REPORT

Inter. Appl. No.

PCT/IT 00/00005

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>DATABASE WPI Section Ch, Week 199214 Derwent Publications Ltd., London, GB; Class A23, AN 1992-108789 XP002134668 & JP 04 046960 A (TOKYO INK KK), 17 February 1992 (1992-02-17) abstract</p>	<p>1-3, 6-9, 26-28</p>
X	<p>DATABASE WPI Section Ch, Week 199144 Derwent Publications Ltd., London, GB; Class A23, AN 1991-321694 XP002134669 & JP 03 215588 A (KANEBO LTD), 20 September 1991 (1991-09-20) abstract</p>	<p>1-3, 6-9, 26-28</p>

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/IT 00/00005

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0555197	A	11-08-1993	CA 2088338 A	30-07-1993
			JP 2662158 B	08-10-1997
			JP 7247413 A	26-09-1995
			US 5346959 A	13-09-1994
EP 0603147	A	22-06-1994	US 5334635 A	02-08-1994
			AT 151802 T	15-05-1997
			CA 2111751 A	19-06-1994
			DE 69309871 D	22-05-1997
			DE 69309871 T	24-07-1997
			ES 2099933 T	01-06-1997
			JP 6256610 A	13-09-1994
			MX 9308083 A	30-06-1994
EP 0423602	A	24-04-1991	US 5223563 A	29-06-1993
			CA 2023401 A	21-04-1991
			JP 3188158 A	16-08-1991
JP 4046960	A	17-02-1992	NONE	
JP 3215588	A	20-09-1991	JP 2795948 B	10-09-1998